Summary Notes from 22 July 2008 Generic Technical Issue Discussion on Long-Term Engineered Cap Performance

Attendees: Representatives from the U.S. Department of Energy (DOE)-Headquarters and the U.S. Nuclear Regulatory Commission (NRC) staff met at the DOE offices in Germantown, Maryland on 22 July 2008. Representatives from South Carolina Department of Health and Environmental Control, DOE-Savannah River, and DOE-Office of River Protection participated in the meeting via a teleconference link.

Discussion: NRC staff prepared and disseminated agenda topics (listed in the next section) summarizing issues and considerations relative to estimating long-term engineered cover or cap performance. A summary of the discussion regarding each agenda topic is provided below. The purpose of this meeting was for DOE and NRC staff to discuss the generic approaches for estimating long-term engineered cap performance unrelated to any specific waste determination or pending DOE action.

Topics: The following four specific topical areas were discussed during the meeting:

1. Documentation of surface cover design features and quantification of processes during operations
2. Model support and technical basis
3. Risk-informed approach
4. Code requirements

Summary: The following summarizes the discussion and the principal points of technical understanding identified during the meeting, unless otherwise noted.

*Documentation of surface cover design features and quantification of processes during operations*

- NRC staff provided an overview of their first agenda topic and noted that DOE should document the types of surface covers chosen to be constructed. Different types of covers are now available (e.g., conventional or alternative including evapotranspiration (ET) covers), and DOE should document the

reason for choosing a particular type of cover, e.g., citing the pros and cons of a proposed cover type at a specific site. The documentation should provide enough detail that the reader can understand the overall make up of the cover and its intended operational purpose.

- NRC staff noted that composition, value, and purpose for each layer of the cover and their integrated effect should be documented including the importance of the layer to the overall performance of the cover. Where individual layers actually work together to produce a joint effect, this should be documented in the discussion of the overall integrated effect. The amount of description should be commensurate with the importance of the layer in contributing to overall performance. For instance, a backfill layer may require less detail than a layer that is significantly restricting infiltration.
- NRC staff noted that present and potential future processes (e.g., degradation, infiltration, erosion) that work inside and on the covers should be addressed. This could include clogging of a drainage layer, bioturbation, deterioration of geosynthetic material, and other processes. It was noted that these processes should also be tied into an integrated conceptual process model of how the cover operates and performs in the long term. Clearly documenting the Conceptual Process Model is critical for understanding performance.
- NRC staff addressed the need to include the water budget (e.g., precipitation, ET, runoff, lateral drainage, soil water storage, and infiltration) over time in describing the operation of the cover. This is important to understanding the overall performance of the cover over the time that it is expected to be effective. The contribution of the major cover components to the distribution of the water budget should be documented. The detail of this description will depend on the type of cover being applied, the expected time of performance, and the half lives of the radionuclides involved.
- NRC staff stated the importance of the cover performance will depend on the purposes that the cover is being used for (e.g., intruder deterrence, waste stabilization, and/or infiltration reduction), the times of effectiveness that credit is being taken, how the cover performance relates to the rest of the disposal system, and the resulting projected dose or risk.
- NRC staff also noted that documentation of the cover and its performance should address the anticipated effects of projected climate states on events

(e.g., precipitation, fire, subsidence, etc.). It would be expected that environments with potential for volatile climatic events (e.g., hurricanes, coastal encroachment) may require more scrutiny. Historic climate variation should be a reasonable starting point for determining the range of variation in climatic conditions that may need to be addressed. Excessive speculation should be avoided in selection of the climate states to be considered. The level of this review would depend on the sensitivity of the model results to climate changes. Changes to the Conceptual Process Model caused by effects of different climate states would need to be documented.

- DOE staff noted that some climate models may show different projected future states. It was agreed that rather than picking one or the other, a sensitivity/uncertainty analysis may be warranted. For example, historical and current weather data, and other site information could be used to establish a broad range of precipitation rates that may be used to simulate both wetter and drier conditions than current averages. If the simulated runoff, erosion, or infiltration results are sensitive to wetter or drier climates, those impacts should be considered. The climate states to be considered may consider temperature, in addition to precipitation, since temperature influences ET. Such issues and decisions concerning selection of the parameter values should be discussed in context of their risk significance to the overall performance of the cap.

*Model support and technical basis*

- NRC staff provided an overview of their second agenda topic and noted that model support and technical basis for the cover is very important. The purposes for a cover could include stabilizing the site/waste, deterring inadvertent intrusion, minimizing infiltration, and/or minimizing gas migration (if relevant).
- NRC staff noted that types of support needed for initial conditions may be different than over time. For example, the technical basis for current ET model parameter values may rely on research and field studies with extensive and comprehensive databases. Future ET model parameter values may rely on an assumption, e.g., the ET rate will remain constant throughout the simulated time period. Such an important model assumption needs to be supported to

the extent practicable. Technical field data may be difficult to obtain and not provide an adequate basis for the assumption, but model support in the form of site specific experiments or tests, natural or man-made analogs, expert elicitations, etc. could provide confidence in the assumption.

- The level of model support for particular aspects of the cover performance will depend on the site-specific factors that affect performance of the cap and the risk-significance to the overall performance.
- NRC staff noted that model support should be commensurate with the natural attributes of the site. For example, at a site that exhibits significant erosion, it would be difficult to develop a technical basis to support not modeling erosion.
- NRC staff noted that minimizing gas migration may be an issue at some sites, and if it is, then it should be addressed.
- NRC staff noted that level of model support was addressed in a previous generic technical issue discussion in general. For covers, NRC staff noted that model support would be needed for the specific performance attributes of particular cover layers. Discussion of what is important regarding the performance of the cap should tie back to the Conceptual Process Model.
- NRC staff noted that there are different types of model support. For example, analogs, these may include natural (geological outcrops) or man-made (old burial sites or previously built covers). Multiple analogs can be useful to support model assumptions. It was also noted that literature reviews can also increase confidence in the model assumptions.

*Risk-informed approach*

- NRC staff provided an overview of their third agenda topic and noted the need to correlate spatial/temporal performance with significance of risk. NRC staff noted that providing this link improves confidence in the analysis. Different types of covers at different sites may have different risks to cover performance. For example, in an area where erosion is important, the risk associated with that process should be reflected both in the analysis and in the type of cover that would be applied.

- NRC staff noted that the spatial aspect of performance includes recognizing that all areas of the cap may not be equally subject to the same forces or have the same performance issues. Risk may be different at different layers also because of how degradation or effects such as clogging of the drainage layer would affect water flow.
- NRC staff noted that if more credit and performance is claimed for a particular attribute, then additional model support and technical basis would be expected. Again, model support and technical basis should also be commensurate with the performance aspects of a particular feature and the overall contribution to performance, including overall performance of the disposal system. It would be expected that there would be more model support and technical basis for the most important attributes to the cover performance.
- NRC staff noted that the Conceptual Process Model should clearly document the interaction-interrelationship between various features, events, and processes of the proposed cover. For example, the erosion rate may affect the infiltration rate which may affect degradation rates. If an increased level of precipitation is assumed in an alternative case, then the associated mechanisms that are affected by increased precipitation should be described and discussed in the documentation. The documentation should explain to the reader the reason for interrelationships and the reason for any assumed deviations.
- DOE and NRC staff noted that not all analysis would necessarily be quantitative. In some case, qualitative analysis would be sufficient.

*Code requirements*

- NRC staff provided an overview of their fourth agenda topic and noted that modeling long-term performance of engineered surface covers should ensure that codes are used for the applications for which they were designed and account for known processes. Codes should not be used for purposes for which they were not intended.
- NRC staff noted that documentation should include why particular codes were used so readers can understand what decisions contributed to the decision to

use one code over another, what their pros and cons are, and why they were chosen for a particular application.

- NRC staff also noted that modeling results should be well documented, including a scenario without an engineered cover so that the impact of the cover can be assessed.
- NRC staff noted that some codes may be considered obsolete, and use of such a code may require additional justification as to why its use is appropriate. It is also appropriate to acknowledge critiques of codes that are being used.
- NRC staff noted that a code that is used for modeling cap performance should be capable of modeling the performance-important attributes of the cap.
- DOE and NRC staff noted that the performance assessment process is an iterative process, and will evolve over time, including improvements to knowledge, data, and codes. NRC staff noted that in future iterations of a performance assessment, if a decision is made to switch codes, then an explanation should be provided as to why the switch was made and why the new code is appropriate.

Conclusions and Actions:

- DOE and NRC staff agreed on the approaches described above related to estimation of long-term engineered cap performance. No outstanding issues were identified relative to these topics at this time.